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THE CONSTRUCTION OF AN ABORIGINAL SCIENCE BIBLIOGRAPHY: SOME ISSUES ARISING

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ABSTRACT

This paper concerns the construction of a bibliography of written materials about Aboriginal science and technology drawn from books, theses, dissertations, scientific and non-scientific journals, conference papers and newspapers etc: in fact, articles about the science and technology that relate in some way to Aborigines, from whatever source, have been included. The articles collected have been listed and classified using Hypercard and major issues and themes have been drawn out of these classifications. It is hoped that the bibliography will be of value in itself and that the categorisation of written materials will clarify the issues.

Additionally a brief questionnaire was sent to each of the State Ministries of Education to find out what had been achieved in terms of Aboriginal science curricula by the States, and this is compared with the current first draft of the "National Statement".

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INTRODUCTION

The purpose of this paper is to explain the way in which the Aboriginal science bibliography was constructed and to indicate how it can be used and to whom it may be useful. The bibliography is a listing of some three hundred and fifty references which relate to Aboriginal science from a wide variety of sources. This should prove useful in itself, but to add to its usefulness as a resource the bibliography has been transferred to Hypercard. Most of the items referenced have a brief annotation and are classified in a number of ways. This should add to the use of the reference for curriculum developers or teachers considering using the "two ways/both ways" approach. The bibliography will thus be available in either as a listing of references or on Hypercard with the references classified and annotated.

CONSTRUCTION

The references were collected by a variety of methods including sorting through all available issues of journals likely to contain pertinent information, collecting references from the reference sections of articles about Aboriginal science and searching conference proceedings of a wide variety of Australian conferences.The usual yearly indexes were utilised and computer searches have been made using the Australian Educational Index (AEI), the British Educational Index (BEI) and

Educational Research Information Centre (ERIC), but these searches proved to be of very limited value in this subject area. This search has now taken a little over two years. Initial results after less than a year were published (Palmer, 1990) and in another paper (Palmer, 1991) some brief comments were made about the lack of research interest in Aboriginal science:

"Aboriginal science is very much a neglected topic". (Palmer, 1991)

This comment can perhaps be amplified with some firmer evidence. For example an article (Grenfell, 1991), which listed and classified sixteen years of articles to the "Queensland Science Teacher" only two out of about 400 relate to Aboriginal science. Similarly an article (Northfield, 1990) lists twenty years of research papers to "Research in Science Education" with again only two articles amongst about 450 articles being on Aboriginal science. Similarly in neither of the two best known Australian science teacher texts can the word "Aborigine" be found in the indexes (White, 1988 : Dawson, 1991), though the latter (p.209) does in fact make a very brief comment. The lack of information about Aboriginal science in such texts, may mean that science teachers-in-training may not have their attention drawn to notions of Aboriginal science, which would be unfortunate. However there are now signs that the area of Aboriginal science is becoming more popular and of greater academic interest in that the articles mentioned were all written within the last five years. The Australian Science Teachers Journal has had five articles on Aboriginal science in the last three years and also in 1990 a major speaker at CONASTA chose this area as his topic for the key note address (Christie, 1991). Even though there have been a number of good recent papers, which this bibliography lists, a further aim of this bibliography is to ensure that good ideas from earlier papers are fully referenced, so that they are not forgotten.

The construction of a standard bibliographical listing needs no explanation, but for the hypercard listing a number of additional classifying systems were used. These and the reason for them will be explained. The idea of "two way direction" has been included as a number of educators believe that the "both ways system" is effective in teaching Aboriginal children. In this approach Aboriginal content may be taught using western methods and conversely western content may be taught using Aboriginal methods, but teachers try to avoid using new/western methods to teach new/western content. Within school contexts the use of these approaches would be under Aboriginal control, within the communities. For the purposes of the bibliography the approach has been simplified so that the symbol A>W indicates that the content or method being described is largely Aboriginal, whereas the symbol W>A indicates that the major part or ideas in the article is western.

In a number of cases the classification could be a subject of further discussion. Overall the aim would be to indicate roughly to curriculum developers which areas had a large Aboriginal content, or was approached from an Aboriginal view point.

The author sought wide overall headings which would include large parts of both western and Aboriginal science. The headings chosen were: Education, Technology, Ownership. Taken with the "two way direction" this provides a total of six different classes which the author hopes will be found useful in sorting out similar areas. Figure 1 illustrates schematically the overall classification system.

In Figure 1 the area in common between the two circles representing the western view of science and the Aboriginal world view (Note 1) respectively, is the content area most likely to be a source of science content for mixed or for Aboriginal schools. This domain has within it three common areas called Humanity and Technology, Humanity and Education and Humanity and Ownership. These would be topic areas around which a common curriculum could be constructed. The contents of the bibliography will also be divided into these areas, though it must readily be admitted that some references do not fit naturally into any of the categories, whilst others might well fit in more than one category.

With regards to the two way approach the treatment of the boomerang might well seem an Aboriginal topic (A>W) and perhaps using some stories of hunting with an experiment with cardboard boomerangs suggested by Liem, 1985 (USA) or the Kiwi boomerang (NZ) (Naera, 1988) this might well be the case. However if one wished to consider the physics of boomerang flight in a year 12 physics lesson this could be done using suggestions by Hansen, 1977 or Hansen, 1989 (UK) but the two way direction is (W>A). In this case the comments in the bibliography should be noted as Hansen manages to admire the sophistication of the boomerang flying without having much respect for its inventors. The nationalities of these authors have been included to illustrate the fact that some items of Aboriginal material culture have become internationalised.

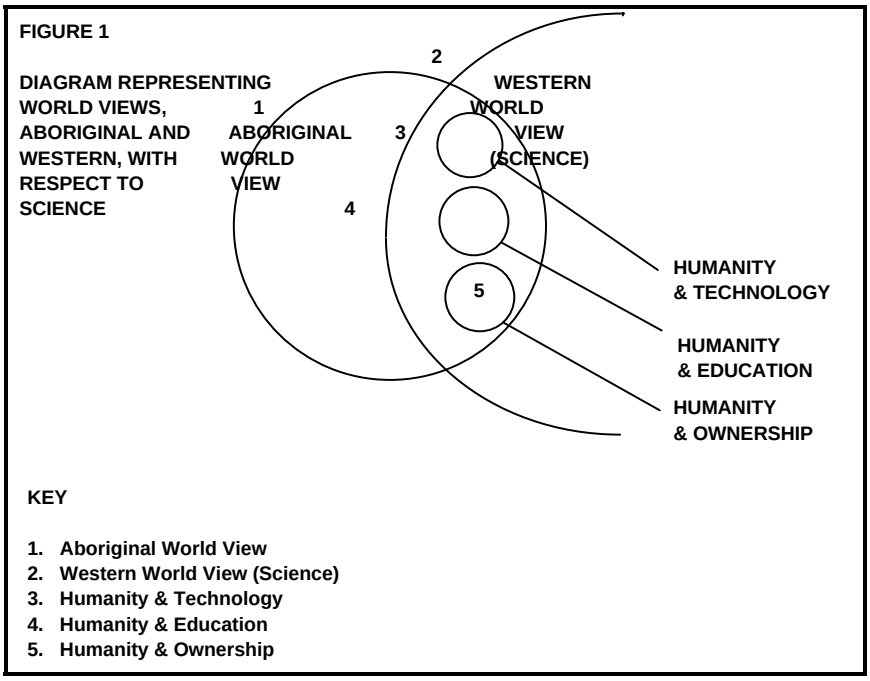

Fig 1 Diagram Representing World Views, Aboriginal and Western with Respect to Science

One other investigation, which was carried out to find out about the aerodynamics of the boomerang will be described (Hess, 1968) because this experiment illustrates the difference of approach between Western and Aboriginal science.To

check if the equations for the motion of the boomerang's flight were correct, Hess made a groove in the central portion of a boomerang into which he fitted two small batteries and connected these to a torch bulb on one of the wings of the boomerang. He threw the boomerang at night and recorded its path photographically. He compared this picture of the boomerang's flight with the paths predicted by a computer using his initial equations and found a good general match. The methodology of the Western scientist described above when compared with an Aborigine skilled in carving and using a boomerang for its purpose of hunting small animals, might illustrate the mutual difficulty of understanding between Aboriginal and Western science. Yet for all the difficulties of understanding aims and purposes, it is in areas like these that Aboriginal students might feel an interest in using Western science to find out more about a topic, such as the boomerang, with which they are already familiar. A further purpose of this bibliography is to find such areas of commonalty between the two sciences.

It is likely that as some new experiments, based on aspects of Aboriginal culture become used in Australian curricula they too will migrate and become a part of the culture of children world-wide. Table 1 shows generally how the topics fit into particular categories, though it must be remembered that topic areas could be in the A>W or the W>A category depending on the way in which the article was written, as in the case of the boomerang above.

Also a key words classification has been included, so have abstracts of many of the articles. These are of different lengths and this ability to cope automatically with lengthy abstracts or none is an extremely useful feature of hypercard. Some abstracts were written by the author, whilst others are sourced as indicated in the bibliography. It should be noted that a number of specialist science education publications (Dawson & Letton, 1989) and (Carmichael et al, 1990) based on databases such as hypercard, though in different formats, are appearing in various fields indicating that such publications are found useful by the science education community. It is hoped that the present compilation will prove equally useful.

TABLE 1
KEY TO CLASSIFICATION OF REFERENCES

MAIN THEMES	A>W	W>A
Humanity and Technology	Aboriginal material culture Boomerang Digeridu Canoes Fishtraps Bush-medicines	Housing design Bush latrines Appropriate technology
Humanity and Education	Land conservation	Primary curricula Secondary curricula Tertiary curricula
Humanity and Ownership	Land Body/skeletons Drugs Petrol sniffing Diet	Mining Uranium Gold Diamonds Manganese Aluminium Cape York space station Western medical help Atomic bomb testing

ABORIGINAL SCIENCE CURRICULA AT THE STATE LEVEL

The science curricula produced by state ministries of education will be looked at, state by state alphabetically. The information for this section comes mainly from the replies to a fax sent to state science advisers earlier this year (Appendix 1). These replies are summarised in Table 2.

The Australian Capital Territory (ACT, 1990) has produced a volume called "From Ochres to Eel Traps"; this seems an updated version of an earlier document (ACT Schools Authority, 1986). It is a resource guide rather than a curriculum, but is a splendid piece of work. It is very brief (37 pages), nicely illustrated, well printed and produced, and inexpensive. It consists in the main of simple practical experiments, which could be used by teachers interspersed with other material or as a unit on its own; it should certainly be on every science educator's bookshelf. The Australian Science Education Project booklets of the 1970s do have references to Aborigines, but there is only one booklet where Aboriginal science can be seen as a major theme; that is "Australians Past and Present" (ASEP 1974). Ritchie and Butler (1990) used this curriculum material as a very interesting piece of research, which suggests that Aboriginal studies in science can foster attitudinal change. Although the curriculum material itself is dated it contained a mixture of traditional and modern Aboriginal perspectives, which the authors of the study felt was appropriate. It may be that future curriculum material should build on this success.

TABLE 2
REPLIES FROM STATE SCIENCE ADVISERS

Results	ACT	NSW	N.T.	Q	S.A.	TAS	VIC	W.A.
States to whom fax sent	Y	N	N	Y	Y	Y	Y	Y
Current work on Aboriginal Curricula	Y	Y	Y	N (1)	N (1)	N	N (1)	N
Future plans for Aboriginal Curricula	Y?	Y?	Y (2)	N (1)	N (1)	N	N (1)	N

1. Queensland, Victoria and South Australia have separate Aboriginal curriculum sections to whom my fax was forwarded, but in these cases there was no indication that any Aboriginal science curriculum existed.

2 The Northern Territory secondary science curriculum has been "on ice" for about a year but it currently looks as if it could progress as a curriculum writer will be employed for six months to complete the current curriculum document.

In New South Wales there is an Aboriginal Education Unit doing excellent work in curriculum preparation. The material (AEU, 1990) so far received is still in draft form (about 100-150 pages) but it indicates that a lot of work has been done, because a high percentage of the content appears to contain ideas adapted from anthropological or archaeological research, written in a form suitable for the classroom. Although some material is for other levels, the majority of materials are for a general science course with an Aboriginal perspective at Y11/Y12 level. The course would aim primarily at useful social knowledge for Aboriginal students, whilst at the same time ensuring a sufficiently rigourous intellectual level to be acceptable for students wishing to continue to tertiary studies.

The Northern Territory population as a whole is about 25% Aboriginal, so it is not surprising that the Northern Territory has been amongst the more active state departments of education in producing special materials for Aboriginal students at all levels of education. There is an early childhood unit called "Environmental Science for Aboriginal schools" (NTDE,undated), which certainly exists as a resource, though the author does not know how much it is used in practice. There is also a well known handbook called "Aboriginal Science Teachers Handbook, incorporating the Milingimbi Case Study" (Davis, Ganambarr & Traynor, undated), though again the amount it is used is uncertain. The handbook is for use in Aboriginal primary schools and for classes of post-primary age students not working to junior secondary core work. It attempts to link the skills required for the concepts and understandings of the Territory core primary syllabus with a sample of understandings of the Milingimbi Aboriginal syllabus. Interestingly enough there were more skills claimed to be taught in the Aboriginal syllabus than in the core syllabus for urban schools. At the time (1980?) it was a very innovative piece of work, but was linked to the Territory Primary Syllabus of that time, which has now changed. Thus further development of the primary Aboriginal syllabus would be needed if centralised curricula are still appropriate. The earlier document could still be the basis for similar attempts at improving Aboriginal primary school curricula elsewhere in the Northern Territory.

There are a series of brief pamphlets for mathematics/science for Aboriginal primary schools (Harris, 1984a,b). There is also a series of eight booklets called Bridging Units (NTDE, 1984), not specifically written for Aboriginal children but written for any children of secondary age who have failed to understand basic concepts in the primary school. These were well written and do seem to be used in practice. The final Northern Territory document (Quong et al, 1990) exists only in draft form, and indicates a shift in interest from primary to secondary curricula. It contains only about 30 pages with a number of sections being planned but not written. It is good in the sense that a start has been made and that plans for exciting work exists, but the material so far viewed does not appear to relate specifically to Aboriginal contexts. However the efforts made so far have allowed the NTDE to fund a writer for six months to get the project completed.

The fax to all other states yielded negative results on science education curricula. The author would be most grateful for information about other curricula at a state level, should the data above prove to be incomplete.

ABORIGINAL SCIENCE CURRICULA AT OTHER LEVELS

It is probably at levels below the state level that numerous Aboriginal science curricula exist. They will exist in various regions or educational areas, at primary, secondary and tertiary levels, or merely as current practice in individual schools or classes. At the primary level changes in other subjects such as language, social science, mathematics or computer syllabi or in administrative structure, will certainly change the science programme in the schools, due to the integrated nature of curricula at this level. Much will go unreported and unrecognised, but the author would hope that a number of successful changes may be recorded.

As examples of existing programmes the Milingimbi science syllabus is recorded (Davis, Ganambarr & Traynor, undated), as is the Yirrkala Community School (Christie, 1991) and so is a generalised Northern Territory environmental programme (Moeckel,1986, see Note 2). At the tertiary level Curtin University has written up its bridging programme in chemistry and mathematics for Aboriginal students giving case studies (Taylor, Malone & Treagust, 1988) indicating the difficulties and successes of students. Examples of overall curricular change include the Desert School curriculum (Vallance & Vallance, 1988) and the change of curriculum at Koonibba (Schulter,1986).

ISSUES FROM THE BIBLIOGRAPHY

Study of the papers gives a host of issues, yet most of these arise from fundamentally different views as to the nature of science itself, perhaps well illustrated by high technology experiments (Hess, 1968) on the aerodynamics of the boomerang. This is both the strength and the weakness of the two way approach. The strength is the ability it gives persons, who start with either a western or an Aboriginal view, to see the other view point. The weakness is that at some time one has to accept one or the other view as being more appropriate for daily life. The author will include at this point some quotations that sharpen the dilemma.

To me the most fundamental principle taught by Aboriginal elders is that our subject matter is to be examined and interpreted within its context. This is in marked contrast with western science where environmental influences are considered confounding, and the scientists do most of their serious work in the laboratory.
(Christie, 1991)

Westerners and Aborigines then contrast both in their views of causal process and also in the kind of abstracted properties which they believe are effective in causation. For these are quantifiable properties such as weight and volume, and for Aborigines these are unquantifiable totemic properties such as "kangarooness".
(Sayers & Bain, 1990, see Note 3).

There is a general consensus by Aboriginal people that there should be objective standards of achievement in English and mathematics
(Jordan. in Harris, 1990, p.25)

It is simply stunning the extent to which we have misunderstood 40, 50 or more thousands of years of Aboriginal culture. How they did change the land; how theirs is the longest continuing technological culture on earth; why they are susceptible to alcohol and high-carbohydrate diets; what their paintings mean, what their land is to them.
(Williams, 1988))

The culture of Aboriginals is such that they do not have any interest, so to speak, in science as we know it .
(Charlesworth, 1982).

By the time Governor Phillip set foot in Farm Cove, our vast continent had been occupied for 40,000 years by the Aboriginal people during which period there was very little evidence of technological ingenuity.
(Anon,1988)

Goal 8. To provide students with an understanding of and respect for our cultural heritage, including the particular background of Aboriginal and ethnic groups, and for other cultures.
(AEC, Hobart Conference (1989, see note 4).

The challenge, for systems, schools and teachers, is to make education available to all students in a manner that accepts rather than suppresses their natural cultural identity. There is a need in many schools for the development of a relevant and locally devised Aboriginal perspective in the science curriculum.
(National Statement, Draft, 1991).

The quotations above have come from a study of the literature that relates to Aboriginal and Western science. Some of the views quoted have failed to make the attempt to understand the viewpoint of Aboriginal science, whilst others have failed to make the attempt to understand the viewpoint of Western science. The last two quotations indicate the approximate end point of the debate, in that they appear to be what national curriculum developers believe is appropriate for all Australian children. It is with this in mind that an Aboriginal science bibliography has been prepared.

CONCLUSION

At the start of this project over two years ago, the author was not sure that there would be sufficient material to form a bibliography. There is in fact a wealth of material though comparatively little of it exists within the confines of science education. The bibliography as prepared is far from complete, but it is hoped that, even as it is, it will be of assistance to enthusiastic teachers or curriculum developers.

REFERENCE NOTES

Note 1 Here and elsewhere in the paper it might be more accurate to say "a western perception of an Aboriginal world view" rather than "an Aboriginal world view".

Note 2 Moeckel, M.J. is only available in manuscript form as:

a) Thematic/Integrated Approach to teaching Environmental Science in Aboriginal Communities NT. (3 November 1986).

Note 3 Sayers, B.J. & Bain, M.S. is only available in manuscript form as:

a) Communication Dilemma: Contrasting Degrees of Abstraction and the Associated Logic, (June 1990).

Note 4 AEC (1989) Goals for Schooling in Australia, Hobart Conference. This quotation refers to all subject areas in the original, but as used in the National Statement (draft) (1991) it refers to the science curriculum.

REFERENCES

ACT Department of Education (1990) From ochres to eel traps. A resource guide for teachers on Aboriginal science and technology. Canberra, ACT, Australian Capital Territory Department of Education.

ACT Schools Authority (1986) Aboriginal science and technology. A draft curriculum guide for science teachers, Canberra, ACT.

AEU (1990) The beginnings of Aboriginal studies in science (course materials from Y7-Y12). Ryde, NSW, Aboriginal Education Unit, Department of School Education, New South Wales Government.

Anon (1988) Technology in Australia; 1788-1988 (Editor F Eyre) (The Lindesay Clark Memorial Volume). Melbourne, Victoria, Australian Academy of Technological Sciences and Engineering, 1-2, 311 & 534-535.

ASEP (Australian Science Education Project) (1974) Australians-past and present .Canberra, ACT, Curriculum Development Centre.

Carmichael, P., Driver, R., Holding, B., Phillips, I., Twigger, D. & Watts, M. (1990) (July) Research on student's conceptions in science: a bibliography. Leeds, UK, Children's Learning in Science Research Group, CSSME, University of Leeds.

Charlesworth, M. (1982) Science, non-science and pseudo-science. Geelong, Victoria, Deakin University Press, l.

Christie, M.J. (1990) Aboriginal science for the scologically sustainable future, Australian Science Teachers Journal, 37, (1), 26-31.

Davis, S, Ganambarr, M. & Traynor, S (undated) Aboriginal science teachers handbook; incorporating the Milingimbi case study. Darwin, Northern Territory. Northern Territory Department of Education.

Dawson, B.E. & Letton, K.M. (1989) Science education research and development abstracts, volume 1. London, UK, The Royal Society of Chemistry.

Dawson, C. (1991) Beginning science teaching. Melbourne, Australia, Longman Cheshire.

Grenfell, A (1991) The Queensland science teacher: cumulative index 1975-1990, The Queensland Science Teacher, 17, (1), 21-44.

Hansen, M.J. (1977) The boomerang, School Science Review , 58, (204), 428-437.

Hansen, M. (1989) The flight of the boomerang, Physics Education, 24, (5), 268-272.

Harris, P. (1984a) Teaching about time in tribal Aboriginal communities (mathematics in Aboriginal schools project 2). Darwin, NT, Northern Territory Department of Education.

Harris, P. (1984b) Teaching the space strand in tribal Aboriginal schools (mathematics in Aboriginal schools project 2). Darwin, NT,Northern Territory Department of Education.

Harris, T. (1990) Talking is not enough. Darwin, NT, (October) Office of the Minister for Education, the Arts and Cultural Affairs, 28-30.

Hess, F. 1968 The aerodynamics of boomerangs, Scientific American, 219, (5),124-136.

Liem, T.L. (1985) The Papercard Boomerang, Invitations to science inquiry. Lexington, USA, Ginn Press, p 306.

Naera, J. (1988) It's a flying Kiwi boomerang, Investigating, 4 , (2), 7-8.

National Statement (draft) (1991) A national statement on science for Australian schools.

Northern Territory Department of Education (N.T.D.E.) (1984) Bridging course in science concepts, (Vols 0-7). Darwin, Northern Territory. Professional Services Branch, Northern Territory Department of Education.

Northern Territory Department of Education (N.T.D.E.), (undated) Environmental science for Aboriginal schools. (early childhood). Darwin, Northern Territory, Professional Services Branch, Northern Territory Department of Education.

Northfield, J.R., (1990) Twenty years of RISE: a cumulative index 1971-1990, Research in Science Education, 20, 326-352.

Palmer, W.P. (1990) An annotated Aboriginal science bibliography, Aboriginal Child at School, 18, (5), 34-43.

Palmer, W.P. (1991) Travels with a scientific purpose, ACENT (Newsletter of the Australian College of Education Northern Territory Chapter), 6, (1), 15-24.

Quong, T. et al (1990) Science education T-10 for Aboriginal schools; a recommended resource (trial edition). Darwin, Northern Territory, Professional Services Branch, Northern Territory Department of Education.

Ritchie, S. M. & Butler, J. (1990) Aboriginal studies and the science curriculum: affective outcomes from a curriculum intervention, Research in Science Education, 20, 249-254.

Schulter, J. (1986) Teaching Aboriginal children: a Koonibba experience, Pivot, 13, (1), 39-41.

Taylor, P., Malone, J.A. & Treagust, D.F. (1988) Case studies of Aboriginal students - a measure of success for tertiary studies, The Aboriginal Child at School , 17(1), 8-24.

Vallance, R. & Vallance, D. (1988) "Punma wangka: a "right way" desert school curriculum 1984-87", Curriculum Perspectives, 8 (2) 71-76.

White, R.T. (1988) Learning science. Oxford, UK, Basil Blackwell.

Williams, R.(1988) Beginnings: the getting of wisdom or the Coca-Cola society, Education Australia, (4), 9-12.

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